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The Role of Scientific Evidence in Canada's West Coast Energy Conflicts

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Abstract

With salience, credibility, and legitimacy as organizing themes, we investigated how opposing communities engaged with scientific information for two contentious proposed energy projects in western Canada, and how their perceptions of science influenced its use in decision-making. The Trans Mountain pipeline expansion, to carry diluted bitumen from northern Alberta's oil sands to tankers on British Columbia's (BC) south coast, was expected to adversely impact biodiversity and contribute to climate change. The Bute Inlet hydroelectric project, a large renewable energy project planned for BC's Central Coast, was anticipated to impact biodiversity but was largely seen as climate-friendly. Based on surveys and interviews with 68 participants who had made one or more personal or professional decisions pertaining to the projects, we discovered that values, cultural cognition, and media effects permeated all aspects of using scientific evidence—from commissioning scientific research to selecting, assessing, and weighing it with other forms of information. As a result, science was developed and used to support positions rather than to inform decisions. We discuss ways to improve the use of science in environmental assessments and other planning and development processes where engaged communities are divided by oppositional positions. We hope this research will lead to community-university partnerships that identify broadly salient, credible, and legitimate sources of information about energy and climate issues, and foster knowledge mobilization across conflict divides.

Introduction

People from all walks of life routinely describe scientific evidence as fundamental to decisions affecting the environment (Lidskog, 2014; Russell-Smith, Lindenmayer, Kubiszewski, Green, Costanza, & Campbell, 2015). At the same time, the level of public trust in scientific communications can vary, and the use of science in decision-making is often unclear (Boon, 2016; Russell-Smith et al., 2015). These contradictions may be due, in part, to the ambiguity of the familiar term, science. Like love or nature, our interpretations rest largely on our life experiences, rather than a shared definition or understanding. Here, we offer the Science Council's (2017) definition of science as "the pursuit and application of knowledge and understanding of the natural and social world following a systematic methodology based on evidence," acknowledging that pursuit, application, understanding, and evidence are vague terms meriting further exploration beyond the scope of this paper.

In a hallmark moment in Canadian politics, science was recognized as foundational to this nation's democracy. In July 2012, some 2,000 scientists and science advocates gathered on Parliament Hill to protest the Conservative government's suppression of publicly funded science and the "death of evidence" in federal decision-making. In a mock funeral procession, they chanted, "No science, no evidence, no truth, no democracy" (Lynk, 2015). The federal government had rolled back environmental legislation, defunded and closed century-old scientific institutions and libraries, and dismissed and muzzled scientists after winning a majority of seats in the 2011 federal election (Lynk, 2015; Solar, 2014). A host of changes in legislation and policy targeted the federal environmental assessment process designed to ease and expedite the development, transport, and export of natural resources—particularly Canadian bitumen, a heavy oil from northern Alberta's oil sands (Mitchell, 2015).

Environmental assessments are conducted to minimize or avoid adverse environmental effects from proposed developments before they materialize (Canadian Environmental Assessment Agency, 2012). Central to environmental assessments is risk abatement, the purview of scientists, among others (Cash, Clark, Alcock, Dickson, Eckley, & Jäger, 2002). Yet, the process is very broad, encompassing, for instance, economic justification and Indigenous rights and interests. All evidence is required to be exposed to both expert and public scrutiny in some form (Sinclair & Doelle, 2015).

How science or scientific evidence is understood and used in environmental assessment is contingent upon its salience, legitimacy, and credibility (Cash et al., 2002; Cravens & Ardoin, 2016). Evidence is salient if it is relevant to the person considering it and the issue at hand (Cash et al., 2002). For example, Stephen Harper, Canada's Conservative prime minister at the time, claimed the decision on Northern Gateway—the first of two proposed pipelines from the Alberta oil sands to the British Columbia coast—would be based on science, not politics, explaining that a decision will be made by scientists examining the economic costs and risks associated with the project (Fekete, 2012). For Harper, an economist, economic tests were more salient than environmental ones, reflecting his conservative values and his view that pipelines were in the vital interest of the country.

Legitimacy is whether the scientific evidence arises from or is embedded in a process that is seen to be unbiased and fair (Cash et al., 2002). From the onset of the review of the Northern Gateway project, the legitimacy of pipeline environmental assessment processes was questioned. Foremost among concerns was that important climate-related evidence was disallowed from the assessments, such as the nature and extent of greenhouse gas emissions from any upstream expansion in oil sands development, or the downstream burning of bitumen products (Gibbs, 2014; Mitchell, 2015).

Credibility refers to whether evidence is believed and trusted (Cash et al., 2002). In June 2014, 300 scientists and scholars sent a letter to the Harper government, saying the Joint Review Panel's report for Northern Gateway had so many systemic errors and omissions that it was essentially useless (CBC News, 2014). The government wholly accepted the panel's recommendations later that month. By stating, "The Panel's rigorous science-based review included feedback from over 1,450 participants in 21 different communities, reviewing over 175,000 pages of evidence and receiving 9,000 letters of comment" (Government of Canada, 2014), it argued the decision was indeed founded on credible and legitimate evidence.

In our study of two contentious proposed energy projects, including a later pipeline project to the British Columbia coast (described in Case Studies, following), actors often called for more science, or disputed the scientific claims offered by others. We encountered a common expression "if they would just look at the science...," implying that people would support the projects if they understood the science and technology in energy development and transportation, or conversely oppose them once they were aware of biodiversity or climate science.

We investigated how science was used in decision-making for these projects, and whether it could play a decisive or unifying role in energy development and environmental protection. Here, decisions included a full range of professional responsibilities and personal choices to provide formal recommendations to government, undertake studies, participate as intervenors or commenters in the environmental assessment process, or be arrested during a protest, for example. Using salience, credibility, and legitimacy as organizing themes, we explored how decision-makers, from unaffiliated citizens to past and present review panel members, perceived science and scientists, discovered and selected scientific information, assessed conflicting science, and weighed science with other forms of evidence and information in environmental assessment decisions. We examined whether elements of the cultural cognition thesis and related social forces (outlined in Theoretical Orientation, below) influenced perceptions and use of science. In so doing, we aspired to improve knowledge translation for environmental assessment and provide potential pathways for more effective public engagement in associated decision-making processes.

Theoretical Orientation—Algorithms, Birds of a Feather, and Cultural Cognition

Projects that undergo environmental assessments are often scrutinized beyond the legislated process, in various forms of public discourse. Yet, public communications now occur in a "post-truth" era, where credible news and information may be difficult to find, and opinion may be shaped more by appeals to emotions and personal beliefs than objective facts (Lubchenco, 2017). News may be framed, spun, and fabricated (Burgers, Jong Tjien Fa, & de Graaf, 2019; Viner, 2016). Journalists chase mouse clicks (Arenberg & Lowrey, 2018), and social media and digital bots create misinformation cascades (Forelle, Howard, Monroy-Hernandez, & Savage, 2015; Pennycook, Epstein, Mosleh, Arechar, Eckles, & Rand, 2019).

In this context, people employ a series of both subconscious and mindful lenses to examine whether evidence is salient and credible. Repetitive news stories and social media posts can trigger an availability effect, where we are more likely to assign significance to a resource for its frequency,

rather than its quality (Kahan, 2012). In distilling some 2.5 quintillion bytes of new daily Internet data into manageable bits (IBM, n.d.), we may ourselves choose predominantly politically right- or left-leaning news aggregators, or environment- or economic-focused listservs that provide a biased sample of news and information. Algorithms also choose for us, filtering digital searches and news feeds to curate and personalize our content so we receive more of what have already received (Pariser, 2011). This filter bubble tends to limit access to information that conflicts with our views (Pariser, 2011). Through homophily, a phenomenon known by the idiom, birds of a feather flock together (McPherson, Smith-Lovin, & Cook, 2001), networked communications tend to circulate information in echo chambers where opposing evidence and explanations are scant (Colleioni, Rozza, & Arvidsson, 2014; Pariser, 2011). Value homophily occurs when we interact more frequently and develop deeper connections with people who share our values, ideologies, beliefs, and social norms (Dale & Sparkes, 2008; McPherson, Smith-Lovin, & Cook, 2001). The distortions of digital media and a tendency to homophily act to reinforce group values and beliefs, contributing to polarization and conflict (Bakshy, Messing, & Adamic, 2015; Dale & Sparkes, 2008).

In-group biases may also shape the selection and evaluation of evidence and experts. The cultural cognition thesis suggests we *conform* to the values and views of groups with whom we identify or share significant relationships, to avoid dissonance, and to protect social standing that might come from deviating from the tendency of the group (Kahan, Jenkins-Smith, & Braman, 2011). We seek information from experts who share our values and are more open-minded to evidence that confirms our personal and cultural perceptions. We tend to dismiss or depreciate information representing a threat to our cultural values and identity (Kahan, et al., 2011). As a result of cultural cognition, a right-leaning scientist may feel more comfortable in the business sector than in a liberal arts academy, or a worker in the fossil fuel industry may not reveal his or her anxiety about climate change (Kahan, 2012; Maranto & Woessner, 2012).

Kahan (2012) also advanced the notion of culturally biased assimilation, whereby we are motivated to absorb and embrace risk information we associate with our cultural group. In studying the perceived risks of nanotechnology, a relatively new scientific field at the time, Kahan, Braman, Slovic, Gastil, and Cohen (2009) found cultural values were more predictive of risk perceptions than the level of exposure to the topic. Kahan (2012) deduced that people could assimilate bias without any prior beliefs, simply by presupposing what their cultural group might think.

We also overestimate the level of scientific support for a position with which we are culturally aligned by more readily recalling instances that support such positions, in what Kahan et al. (2011) referred to as the cultural availability effect. And, in identifying credible experts, there is a tendency to impute knowledge, honesty, and shared interests to people we perceive to share our values. Kahan (2012) called this the cultural credibility heuristic.

At the same time, people have unequal direct access to scientific evidence (Enserink, 2016; Porter, 2012) and unequal opportunities and abilities to fully understand and evaluate environmental assessment information. To manage complex conflicting or uncertain information, we lower the effort needed to form or modify beliefs by relying on cognitive shortcuts—trusting in a political party or media outlet, deferring to the expertise and views of others, or simply arguing positions in terms of values (Kahan, et al., 2011; Miscolta-Cameron, 2016).

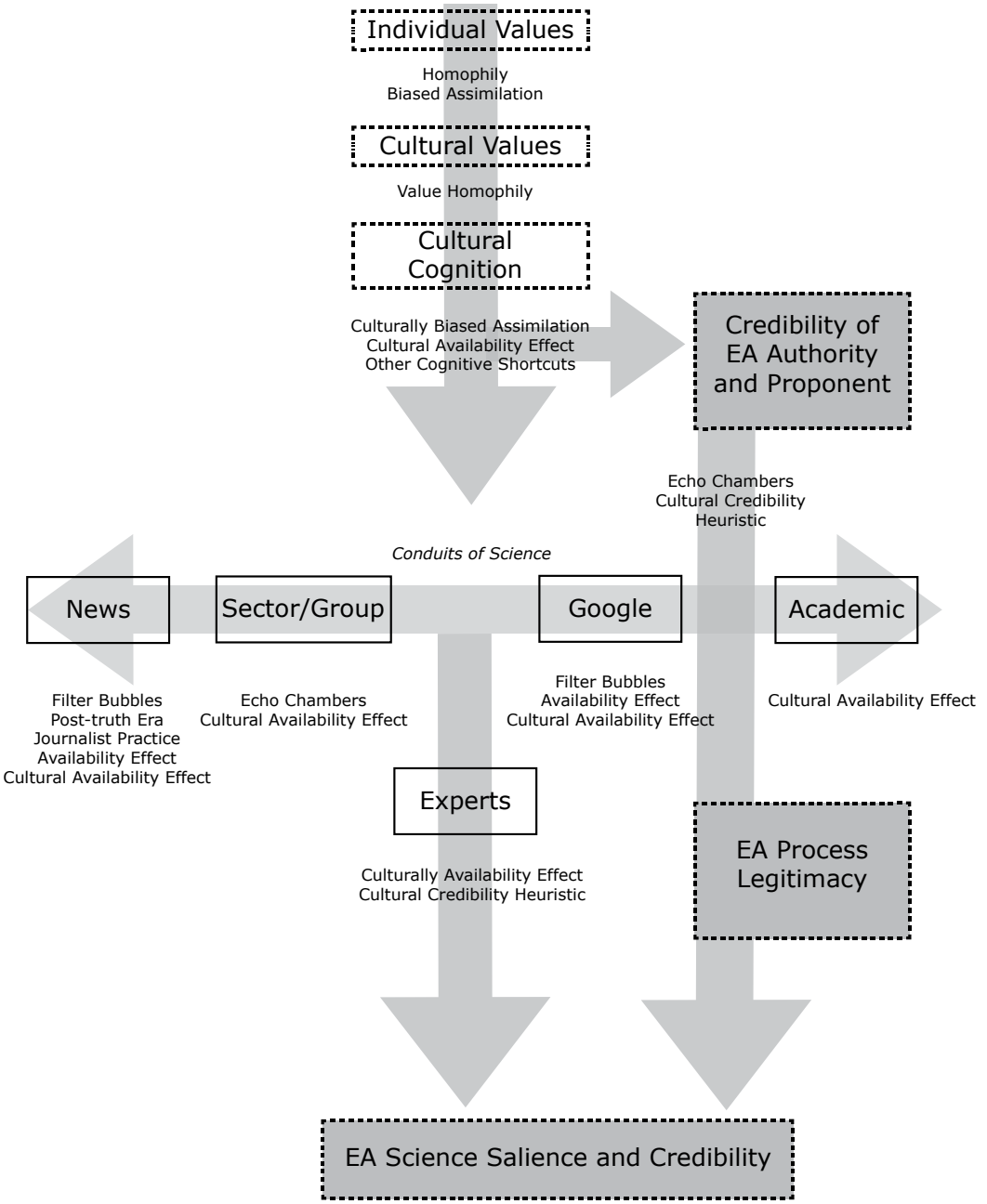
Some values, including those invoked in economy versus environment conflicts, are known to be in opposition to one another (Clermont, Dale, King, & Reed, 2018; Schwartz, 1992). For example, Schwartz found that individuals cannot simultaneously prioritize self-enhancement values such as power and achievement with self-transcendence values involving concern for others and for nature. When prioritizing values, strongly held values will generally outcompete weaker ones (Schwartz, 1992). Where there is value tension—situations where conflicting values are of approximately equal stature—people are less confident in the correctness of their positions, more open to information, and more likely to invoke more complex reasoning (Kristiansen & Zanna, 1994; Tadmor & Tetlock, 2007; Tetlock, 1986). By contrast, strong values and strong emotions triggered by a values conflict are tied to low complexity in thinking and less interest in rational argument (Henik, 2008).

Those who have strong values, such as keen partisans, are most susceptible to biased assimilation, a form of information processing where evidence confirming one's beliefs is readily accepted, while disconfirming evidence is subjected to hypercritical evaluation (Lord, Ross, &

Lepper, 1979). Laypeople and scientists alike may cling to attitudes reflecting only vague impressions and unproven assumptions, despite the availability of confounding evidence. In a renowned study of attitudes toward capital punishment, Lord, Ross, and Lepper (1979) found the gap between people with opposing views increased when exposed to identical evidence.

Due to values, homophily, and cultural cognition—and external effects such as media that precipitate filter bubbles and echo chambers—individuals and factions on either side of a contentious project may have different perspectives as to what they see as salient, credible and legitimate (Figure 1).

Figure 1. Influences on Perceptions of Science in Environmental Assessment



Case Studies

Trans Mountain Pipeline Expansion

Kinder Morgan Canada filed its proposal for the Trans Mountain Pipeline Expansion with Canada's National Energy Board (NEB) in December 2013. The pipeline would increase the levels of diluted bitumen flowing from Alberta's oil sands to British Columbia tidewater for export (Figure 2), thereby reducing Canada's reliance on exports south to the United States. Of 2,118 applicants, 400 intervenors and 798 commenters were allowed to participate in the Expert Panel for the Review of Environmental Assessment Processes (Expert Panel, 2017). The Conservative federal government had limited public participation by narrowing the definition of standing in environmental assessment from "any interested person," to those "directly affected" or "with relevant information or expertise." Protests and other forms of resistance confronted these restrictions on participation as well as a suite of other issues, such as the risks of greenhouse gases and tanker spills from anticipated increases in bitumen production and use. In the fall of 2015, a new federal Liberal government was elected, promising to restore trust in the assessment process and make decisions based on "science, facts, and evidence" (Liberal Party of Canada, n.d.) However, the NEB process proceeded unchanged, recommending approval of the project in May 2016. Ongoing dissension prompted the government to appoint a panel to collect additional information. The Ministerial Panel for the Trans Mountain Pipeline Expansion Project (2016) received nearly 2,500 participants at 44 meetings in 11 cities, as well as 20,154 email submissions and 35,259 responses to an online questionnaire, the highest response rate ever recorded for a federal government questionnaire. It identified gaps in the NEB process, such as the absence of a comprehensive national energy strategy, and prior commitments to climate action and Indigenous people. When the project was approved in November 2016, opponents pressed on with protests, court challenges, and civil disobedience (e.g., Hume & Bula, 2016). To cement its jurisdiction over the project, the federal government purchased the pipeline in 2018. In August, the Federal Court of Appeal quashed the project, finding marine impacts and Indigenous consultation had been inadequately addressed. Amid continued opposition, the government approved the project again in June 2019, asserting these issues had been newly addressed and vowing to direct profits from the project toward clean energy projects.

Figure 2. Case Study Areas: Trans Mountain Pipeline Expansion (TMPE) and Bute Inlet Hydroelectric Project (BIHP)

Bute Inlet Hydroelectric Project

To explore whether our findings were isolated to fossil fuel energy projects, we included Plutonic Power's Bute Inlet Hydroelectric Project. Comprised of 17 non-storage run-of-river sites on three river systems, it was the largest of its kind (Costello, 2016). Proposed for British Columbia's Central Coast, it was part of a Green Power Corridor that would meet the power needs of 586,000 homes, create 5,900 person-years of employment, and offset 4 million tons of annual carbon dioxide emissions (General Electric, 2009).

The company bid into BC Hydro's Clean Power Call and submitted to the British Columbia environmental assessment process (Plutonic Power Corporation, 2008). The first open houses in early 2009, to develop a Terms of Reference for environmental assessment, were crowded and confrontational (British Columbia Citizens for Green Energy, 2009). A federally appointed review panel began to lay the groundwork to assess the project. (In Canada, environmental assessments may be federal, provincial, or cooperative endeavors, depending on the size and potential impacts.) However, the proponent suspended the environmental assessment to collect additional data. The project was formally withdrawn in 2016, when the entire independent power sector

stalled due to the development of Site C, a large hydroelectric project in northeast British Columbia (Bennett, 2016) (Figure 2).

Methods

With our research approved by Royal Roads University's Research Ethics Board, we began identifying potential participants from online media, environmental assessment documents, and referrals from other participants. Sixty-eight participants accepted our invitations, representing 11 actor types and 13 organization types (Table 1 and Table 2) (Clermont, 2018). Of these, 54 had engaged with the Trans Mountain project and 14 with the Bute Inlet project. At least seven were First Nation or Métis. Nearly 87% of Trans Mountain participants and 79% of Bute Inlet participants had post-secondary or professional credentials.

From January 11 through November 15, 2016, recruits were asked to respond to five surveys addressing values, views, networks, reports, and decisions, and to participate in semi-structured, follow-up interviews (Clermont, 2018). Collectively, respondents completed 270 surveys. Thirty Trans Mountain Pipeline Expansion and Bute Inlet Hydroelectric Project recruits participated in follow-up interviews. Since the majority of participants were opposed to the projects (79%), we requested and generally received more interview time with project supporters.

In surveys, participants were queried for their views (e.g., comparing science with other forms of knowledge and public opinion), and self-enhancement and self-transcendence value priorities (Clermont, 2018; Schwartz, 1992). Self-enhancement scores measured achievement and power, self-transcendence social scores measured concern for others, and self-transcendence nature scores measured concern for nature (Table 3). Network surveys traced the flow of information and financial resources, as well as the level of cooperation and collaboration among individuals and groups. To help determine what scientific information participants were accessing about the project and how they perceived it, survey respondents were asked to rate the accuracy of reports in a reports survey. Items for this survey were selected through online searches, using the projects as search criteria. Participants were not required to read the reports in the reports survey, only to base their ratings on what they already knew. Network and report survey respondents were asked to nominate additional organizations and reports, respectively, and these were added to the surveys as they became known. The reports covered a range of types (for example peer-reviewed, gray literature), authorship, and topics related to the projects. Additional reports, news articles, and other information mentioned in participant intervenor and commenter documents were analyzed for salient topics. The decisions survey offered a checklist of different types of responsibilities or choices participants might encounter as they engaged with the project.

Statistical analyses, including correlation, contingency tables, and non-parametric tests were used to examine survey data in SPSS version 23. A factor analysis was performed to evaluate and confirm the validity of values scores. To examine network data, we constructed bipartite

Table 1. TMPE and BIHP Actor Types

Actor Type	No. of Participants
Academic	6
Activist	12
Accredited Professional	5
Business Owner	1
Citizen	9
Communications	7
Government Employee	2
Organization Aide	1
Organization Leader	16
Review Panel	2
Political Leader	7
Total	68

Table 2. Organization Types

Organization Type	No. of Participants
Academic	7
Corporate Oil and Gas	6
Corporate Renewable	3
Environmental	12
Government/Political/Regulatory	9
Indigenous	1
Issue-based	6
Media	2
None	16
Theological	1
Resource/Development/Business	2
Small Business	2
Union	1
Total	68

Table 3. Value Scores and Support for Energy Projects

Values scores were computed from best-least choices in the values survey (Finn & Louviere, 1992), with the formula: SE score = ∑(SE best)-∑(SE least)/∑(all possible SE best). Self-transcendence (social) (STS) and (nature) (STN) values scores were similarly derived. STS scores emphasized concern for others, whereas STN scores indicated concern for nature. Only statistically significant scores are included.

Value Score	View	Spearman's Rho Correlation	Crosstabulation Chi-Square and Cramer's V
SE	Support energy products	0.371**	χ (7)=33.515, p=0.000, Cramer's V=0.741, n=61
	Support environmental protection	-0.371**	χ (7)=24.507, p=0.001, Cramer's V=0.624, n=63
	Oppose TMPE[1] or BIHP	-0.606**	χ (14)=49.852, p=0.000, Cramer's V=0.619, n=65
STN	Support energy projects	-0.295*	χ (5)=13.706, p=0.018, Cramer's V=0.474, n=61
	Support environmental protection	0.428**	χ (5)=15.107, p=0.01, Cramer's V=0.49, n=63
	Oppose TMPE or BIHP[1]	0.478**	χ (10)=24.474, p=0.002, Cramer's V=0.46, n=65

**p<0.01, *p<0.05

SE scores ranged from -1 to +0.4, STN scores ranged from -1 to +1. STS scores, which were not significant, ranged from -1 to +1. Due to small sample sizes, chi square cell counts were commonly less than expected. Values and views statements were approximately ordinal; there may be order and overlap effects

[1]TMPE (Trans Mountain Pipeline Expansion), BIHP (Bute Inlet Hydroelectric Project)

net graphs with directional ties and performed network analytics using Gephi version 0.9.1 and Kumu 2017 network software. Follow-up interviews were recorded and transcribed into MAXQDA version 11. Segments were deductively coded to align with survey responses and theory (e.g., salience, credibility, and legitimacy), and inductively coded to identify emergent themes. These multiple sources of evidence and analyses were systematically integrated and triangulated in explanation-building (Clermont, 2018).

Expert Panel for the Review of Environmental Assessment Processes

Additionally, we juxtaposed our findings with the policy recommendations of the Expert Panel (2017), exploring their implications for environmental assessment and future research. For decades, Canadian environmental assessments had been criticized for incorporating poor quality science and generally undervaluing science in the environmental assessment processes (Greig & Duinker, 2011). The Expert Panel was convened in 2016 by Canada's Minister of Environment and Climate Change "to restore public trust in environmental assessment and get resources to market" (Expert Panel, 2017, p. 2). The Panel received nearly 400 presentations, as well as some 500 written submissions and 2,600 completed surveys. Its recommendations reflected a nation-wide engagement process with more than 1,000 people in 21 cities over four months. In its final report, the Expert Panel redefined environmental assessment as Impact Assessment, based on five pillars of sustainability: environmental, economic, social, cultural, and health.

Results and Discussion

Credibility: Science, Sources

Nearly 20% of participants were conflicted or otherwise troubled by the term science. They characterized it as a means of knowing (e.g., an incremental method reaching for facts or truth), or less frequently as a body of knowledge (e.g., a collection of probabilities and scenarios). Participants who self-identified as religious or spiritual often had unique views on science; one described it as an "unnecessarily dispassionate and detached spiritual practice."

Participants described science as objective or fact, yet too malleable to be blindly trusted. Most frequently, the soundness of science was premised on issues of legitimacy, such as funding sources. Science produced by or for industry, government, non-profit organizations, and environmental campaigns were all dismissed by certain participants as suspect. Some participants accepted that corporations and their consultants produced biased science, while governments and non-profits were expected to be more even-handed.

Participants widely acknowledged that environmental assessment science was selectively created or used to win project approval or denial, rather than aspire to some truth. However, there were subtle but critical differences in how some participants perceived the role of science in environmental assessment, most notably whether it was to find proof, falsify existing information

Table 4. Value Scores and Views on Science

Case	Values Score[a]	Views Statement	Spearman's Rho Score	Significant Crosstabs
[1]TMPE	SE	Biodiversity science is one of the most important considerations in decisions for lands and resources because the risks are too great if ignored or minimized.	-0.310*	–
TMPE	STN		0.302*	–
TMPE	SE	Biodiversity science is less important than most other considerations in land and resource decisions.	0.356*	χ(6)=31.972, p=0.000; Cramer's V=0.808, n=49
TMPE	SE	Compared to biodiversity and climate science, other types of science, such as economics, are equally or more important in decisions for lands and resources.	0.421**	χ(6)=17.643, p=0.007; Cramer's V=0.619, n=46
[2]BIHP	SE		0.829**	χ(4)=9.870, p=0.043; Cramer's V=0.871, n=13
TMPE	STN		-0.491**	χ(4)=11.886, p=0.018; Cramer's V=0.508, n=46
TMPE	SE	Compared to academic or government science, local and/or Indigenous knowledge and experience should be considered equally or more important in decision-making for lands and resources.	-0.445**	χ(6)=17.643, p=0.007; Cramer's V=0.619, n=46
BIHP	SE		-0.829**	χ(4)=9.870, p=0.043; Cramer's V=0.871, n=13
TMPE	STN		0.397**	–

[a]There were no significant correlations with STS score, nor any significant correlations between any values score and the views statements:
- Biodiversity science is one of the most useful in decisions for lands and resources because it is factual and objective.
- Climate change and biodiversity loss are distant threats, and there is much to be determined before they can be weighed against other factors in decision-making for lands and resources.
- Scientific evidence has shown that climate change and biodiversity loss are interconnected and pressing problems that must be considered in all land and resource decisions.
- Climate change is more urgent/pressing than biodiversity loss, and must be considered in all land and resource decisions.
- Compared to science, public opinion should be considered equally or more important in decisions for lands and resources.

(Only statistically significant scores are included.)

[1]TMPE (Trans Mountain Pipeline Expansion)
[2]BIHP (Bute Inlet Hydroelectric Project)

(i.e., the exception tests the rule), or inform the process (i.e., neither proving or disproving). If one viewed science as proof, uncertain evidence should be excluded. Those who believed science was more suited to falsification referenced the Precautionary Principle, an ecological Hippocratic Oath to err on the side of caution when science cannot fully address uncertainty or complexity (The World Commission on the Ethics of Scientific Knowledge and Technology, 2005). When science was simply perceived as information, uncertainty merited further inquiry. In this paper, the term uncertainty is broadly used to refer to knowledge gaps, with little focus on its characteristics or how it is communicated (van der Bles, van der Linden, Freeman, Mitchell, Galvo, Zaval, & Spiegelhalter, 2019).

Positions on the projects and perceptions of certain branches of scientific study were reflected in participants' values scores. People who prioritized self-enhancement values were significantly more likely to support the proposed energy projects as well as hypothetical energy projects, while those who aligned with self-transcendence values were more likely to be against them (Table 3). Among those with higher self-enhancement scores and lower self-transcendence-nature scores, economic science generally ranked higher than climate science and biodiversity science; for participants with lower self-enhancement scores and higher self-transcendence-nature scores, this was reversed (Table 4). Some Trans Mountain opponents, including professors, were irked that "economics" held such prominence in decision-making. They diminished its value because it was "not a natural science" or dismissed the notion that it was a science at all. It was blamed for climate change and other market failures, and for elevating the significance of jobs over "growing food, drinking water, and breathing air."

Since key and final decision-makers frequently have corporate legal and business professional backgrounds that include training to find evidence to support a case or advance a position, and work within cultures that reward self-enhancement values like achievement and power (e.g., Chan, 2014), they are more likely to see science that lends support to development as more credible.

Several participants classified Indigenous knowledge as science, consistent with the findings of the Expert Panel (2017). One reasoned, "ten thousand years of observing patterns is science." A Chief explained that spirituality is intrinsically embedded in Indigenous knowledge, by seeing

knowledge as "teachings" and adopting a holistic, systems-based approach guided by nature's own regulations "built in by the Creator." Local residents and Indigenous people—regarded by some as inherently local—were viewed as having "first-hand, "common sense" knowledge. Local people had spotted errors in the Trans Mountain application, and understood watershed dynamics that could damage hydroelectric infrastructure, for example.

The lower the self-enhancement score, the more likely participants were to say "Indigenous and local knowledge should be considered equal to academic or government science in decision-making for lands and resources," with 87% of project opponents prioritizing this statement compared to only 15% of supporters (Table 4). One supporter suggested local knowledge be limited to purely local decisions, and case-by-case in issues of national importance. Local knowledge, noted one Bute Inlet participant, crucially bridges the disconnect between our global use of goods and on-the-ground impacts. "I don't see what's happening..., but the people who live in the area see what's happening." For others, the relative importance of Indigenous and local knowledge was an issue of social justice, the right to be heard and have a say in what should happen in one's own territory or backyard.

In environmental assessments, investigative reporters, lawyers, academics, applied scientists, government staff, industry, non-profit groups, panel support staff, and intervenors were all identified as experts to which people deferred. People differentiated experts from non-experts in the following ways: Experts are individuals with considerable, specific, on-the-ground technical expertise (e.g., an expert in river crossings), individuals with an ability to critically examine information (as opposed to manage or regulate projects), producers of peer-reviewed science who were willing to be cross-examined, and professionals constrained by legislation or codes of ethics. Participants from industrial or business sectors most frequently referenced themselves as experts.

All but one participant felt public opinion was less important than science and local or Indigenous knowledge. Trans Mountain participants, apparently unswayed by the unprecedented level of awareness and engagement with the project, rationalized this view by describing the public as a lay-public. The contradiction appeared to be rooted in what being informed entailed. For example, a communication specialist said, "It's your duty as a citizen to get informed about something that you're going to speak passionately about," admitted to knowing much about the pipeline industry and little about the project.

Public opinion was frequently linked to values and views, which some participants perceived as valid and persuasive forms of evidence, and others did not. Notably, the NEB and other quasi-judicial courts are obligated to include as evidence facts that are not scientific, such as "I don't feel safe." Further, participant and public submissions to the board nearly always infused scientific evidence or local knowledge with values, views, and sense of place. For example, people addressed risks to the Southern Resident Killer Whale population while describing the beauty of the coast, meaningful experiences with family, and concerns for how an oil spill might impact all of these. Others felt "emotive" statements weakened the case people were trying to make.

Some participants were understandably hesitant to clarify their views on the credibility of certain sources, since diminishing the importance of Indigenous knowledge may be perceived as racist, or dismissing public opinion as autocratic. Yet, the degree to which Trans Mountain participants viewed a source as generally credible was reflected in how legitimate they perceived its role in the environmental assessment process (see Legitimacy, following). We see credibility issues as leverage points in resource conflicts. Careful strategies to make these issues explicit and to fairly assess sources should de-escalate conflicts while making decision-making more robust.

News, Networks, and Sinking Bitumen

Most participants believed scientific evidence was more reliable than information arising from news media or from their own organizations or sectors (92% of Trans Mountain and 92.3% of Bute Inlet participants). However, people often accessed science through news media and sector materials that interpreted the information. Project supporters primarily chose proponent materials (34%), news media (25%), and sector materials (17%) as conduits for information. Opponents were more likely to turn to their networks (35%), or to access a variety of materials with no one information source predominating (35%) (Figure 3). There were similar relationships among information conduits and participant values. For

Figure 3. Primary Project information Sources. Balanced Mix=Confirmed Mix as well as Those Who Claimed a Mix. Other=Government Sources, Search Engines. $\chi(5)=9.589$, $p=0.088$; Cramer's $V=0.429$, $n=52$.

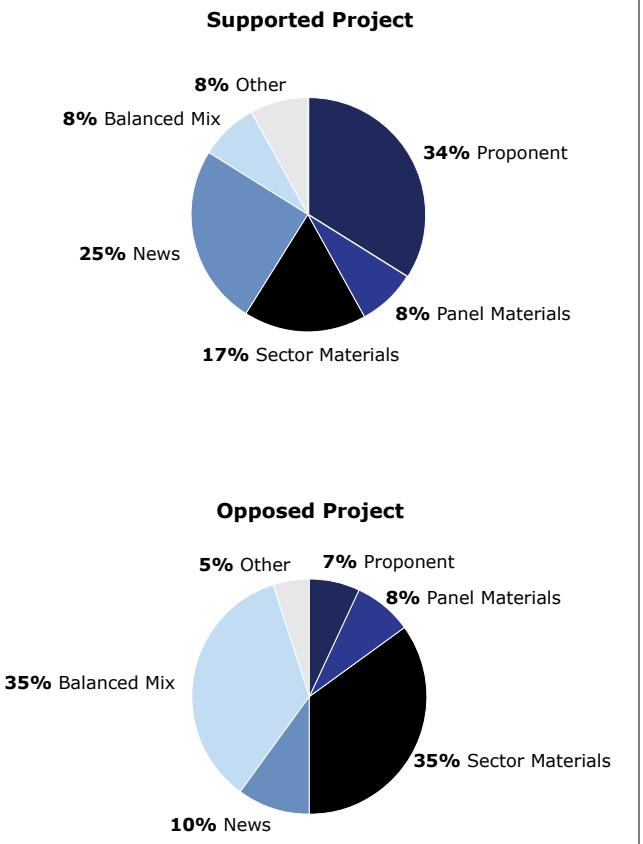
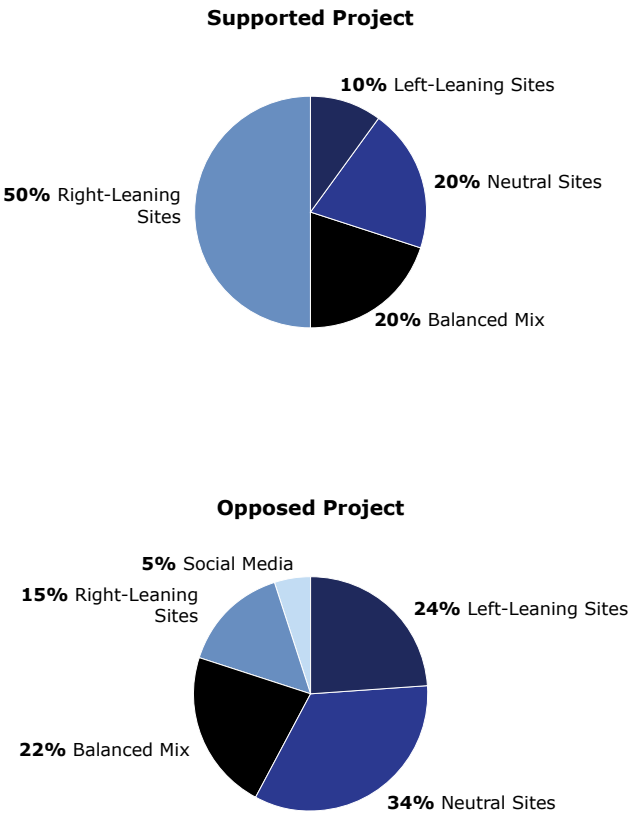


Figure 4. Routinely accessed news sources. $\chi(4)=13.674$, $p=0.008$; Cramer's $V=0.528$, $n=49$. If lean could not be confirmed by content or references, the source was deemed neutral (e.g.,Gutstein, 2011).



example, participants with low self-transcendence-nature scores accessed information primarily through news and proponent materials. Less than a quarter of participants accessed news from a variety of sources equally weighted to politically neutral or left- and right-leaning sites, with project supporters much more likely to prefer right-leaning sites (Figure 4). At the same time, more than 80% of participants ranked information from others in their organization or sector (e.g., environmental non-profit sector, oil and gas sector) as more reliable than news media. Since news selection and political ideologies are linked (Anderson & Coletto, 2017; Mitchell, Gottfried, Kiley, & Matsa, 2014), and organizations and sectors have their own cultural values, these tendencies expose people to filter bubbles, echo chambers, and availability effects (Kahan, 2012; Pariser, 2011).

An exemplar of how media selection might exacerbate conflict arose when both the Northern Gateway and Trans Mountain pipeline projects were in the news. Media outlets published perfectly contradictory headlines referencing the same 2013 Government of Canada report. Lab research had shown that fine sediments and high-energy wave action caused diluted bitumen (or dilbit) to sink or be dispersed as floating tarballs, whereas it floated on sediment-free saltwater after evaporation and mixing. The authors concluded the behavior of bitumen in seawater depends on exposure to natural processes. On the release of the report, *The Globe and Mail* explained the findings verbatim (Luk, 2014). At the same time, right-wing journalist Tom Fletcher (2014) penned "Bitumen floats at sea, study finds"; in this context, dilbit floats unless mixed with some types of

sediment. *Desmog Canada* headlined, "It's Official: Federal Report Confirms Diluted Bitumen Sinks" (Linnitt, 2014). These stories were reprinted by media outlets with similar leaning positions on the projects, amplifying their reach. With fully half of Trans Mountain supporters gravitating to mostly right-leaning news media (Figure 5), and more than a third of opponents looking to their networks for information, some were exposed and vulnerable to biased interpretations.

We found networks on both sides constrained broader information-seeking and critical thinking. Characteristic of culturally biased assimilation (Kahan, 2012), participants rarely questioned information emanating from their trusted networks. Notably, this extended to positions as well as evidence. One participant admitted his professional organization supported the Trans Mountain for purported economic benefits to its members without evaluating those benefits or considering other factors.

At least 39% of Trans Mountain and 56% of Bute Inlet participants had been involved with developing or commissioning scientific reports for the environmental assessment, or in crafting applicable standards or guidelines to which the projects should adhere. However, they were unlikely to review a scientific report associated with the project unless they were required to read them for their work. Most participants had read fewer than a quarter of all the reports in the initial reports survey (Figure 5), with 37% of Trans Mountain participants and 8% of Bute Inlet participants completely unfamiliar with them.

Most participants (80%) read at least some of the foundational materials of the projects, such as the Trans Mountain application or the Bute Inlet project description and terms of reference. Plutonic Power's (2008) project description totaled 30 pages, and the 50-page Terms of Reference was developed jointly by federal and provincial environmental assessment authorities from a draft that underwent public review. By contrast, the Trans Mountain application was described as an onerous, massive, repetitive, technical document designed to intimidate and discourage people from engaging with it. Nearly every Trans Mountain participant remarked on the time and effort involved in assessing the application, as well as their own ability to do so, justifying their reliance on teams of staff, caucus researchers, and experts to review and interpret the content of its estimated 15,000 to 23,000 pages. Even individuals identified or who self-identified as experts admitted to using second-hand information from others, rather than reviewing the application themselves. With other cognitive shortcuts at play, it is likely the cultural credibility heuristic was too.

Whether and how participants examined other reports depended largely on their roles and objectives. Intervenors were more likely to scrutinize proponent reports and offer peer-reviewed contradictory evidence, while most commenters referencing reports looked for publicly accessible material to support their arguments. Participants who self-identified as campaigners or activists looked to reports for the "juiciest fact" to persuade the public or decision-makers. Project supporters were less familiar with reports on topics that were outside of the scope of the project set by the NEB, such as climate. By contrast, climate was highly salient in materials used by Trans Mountain opponents, reflecting participants' convictions that this topic should have been included within the scope of the environmental assessment (Table 5 and Table 6).

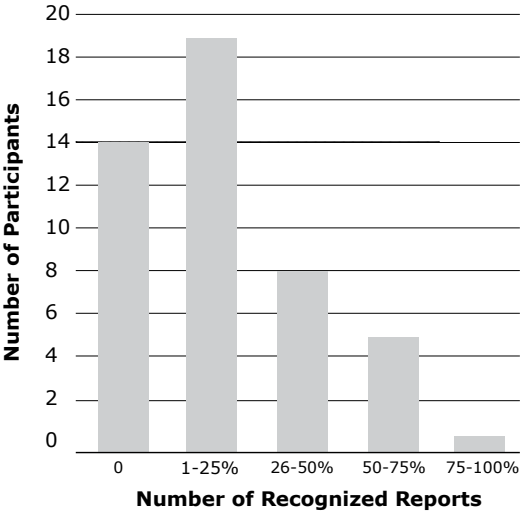
Of those who had read the reports in the survey and were willing to attest to their accuracy, all rated academic, peer-reviewed articles as mostly or completely accurate. Whereas Trans Mountain supporters and opponents often perceived the accuracy of reports differently, Bute Inlet respondents were more likely to agree, regardless of stance. In interviews and in their correspondence to the NEB, Trans Mountain participants identified 191 references additional to those in the reports survey, most of which were academic, peer-reviewed articles and government reports on spills and biodiversity (Table 5). They also referenced 126 news articles and blogs, mostly pertaining to spills, again demonstrating the influence of news media in environmental assessment (Table 6).

Salience

Planning to fail early

Although the Trans Mountain application was filed with the regulator in December 2013, consultations began in 2011 and field studies were in progress by April 2012 (Trans Mountain, 2013). Hydrological data collection for the Bute Inlet project began in 2003, with engineering, environmental, and other studies well underway before the company submitted its proposal into the environmental assessment process in 2008 (Plutonic Power Corporation, 2008). In other words, the proponents and their hires spent years

Figure 5. Familiarity with reports in the survey, excluding reports added by participants, n=47



working within defined regulatory parameters and with guiding documents to develop their projects in preparation for environmental assessments.

Participants familiar with renewable power development explained that companies collect data on numerous prospective sites before entering highly competitive bidding processes. A primary goal at this stage is to avoid valued components such as species-at-risk occurrences and Indigenous sacred sites, as well as landslide or other hazard areas. Any of these could slow or kill a project, or create costly management challenges once the project is built. Front-end data collection and planning allow projects to fail early, before substantial financial resources are invested.

Participants familiar with the development of the Trans Mountain project explained that proponent representatives consulted landowners and others to identify issues, address potential incompatibilities, lay the foundation for ongoing relationships, negotiate deals to facilitate access or land use, and plan to mitigate or compensate for degraded or destroyed habitat. By contrast, the Expert Panel (2017) suggested proponent-driven pre-environmental assessment planning is siloed and devoid of diverse knowledge and expertise.

Generally, the types of information deemed salient by proponents, regulators, and project supporters were technical and logistical, such as the safety record of pipelines, proximity of transmission lines, or whether landowners had signed agreements. Environmental assessment processes had legitimacy among supporters largely because they were confident that salient issues had been identified and managed before formal consultative processes were even underway.

Policy Wars

Opposition was driven largely by real or perceived strategy and policy vacuums—on energy, climate, spill response, land use, and cumulative effects. The Expert Panel (2017) and Ministerial Panel (2016) similarly noted that a lack of clarity and consistency in climate and energy policy led to more adversarial environmental assessments. With no venue to have the types of policy discussions that might take place in higher level planning processes, and a legalistic environmental assessment setting where analysis is confined to the proposed project and there is little, if any room for alternatives or innovation, the projects ignited and amplified a gamut of tensions. Unable to address these broader issues in any meaningful way, companies responded with promotional public relations that did not, and arguably could not, address such problems. Efforts to quell broad policy arguments in environmental assessments by delimiting narrow parameters for greenhouse gas emissions and other considerations only inflamed tensions and raised concerns about the democratic process. Too late, the NEB in 2016 offered this on its website: "We do not create or debate federal energy policy. The Parliament of Canada and its elected officials have that mandate."

If a project is proposed, its first test is whether it fits within existing plans and established policies. On British Columbia's Lower Mainland, participatory and science-based regional and municipal plans and bylaws defined no-go zones, determined compatible uses, and dictated the extent and pace of development. For the Trans Mountain project, the first test was tree cutting for surveys in Burnaby Mountain Conservation Area in 2014, which incited protests and arrests. The board ruled the City of Burnaby's bylaws were inoperative or inapplicable, citing the doctrines of federal paramountcy and interjurisdictional immunity.

Bute Inlet opponents viewed the project as the largest of many in a "gold rush" of stream-staking and power development. Coarse, landscape-level planning had led the province to locate run-of-river projects on British Columbia's Central Coast. The Western Renewable Energy Zones initiative had produced a ranked inventory of 8,242 potential run-of-river sites in 11 U.S. states, parts of Mexico, Alberta, and British Columbia (Pletka

& Finn, 2009). This initiative, however, was neither well known nor conducted at a regional planning scale befitting the environmental assessment project. Characteristic of many participants, one remarked, "It was left to...this strange, free market type of situation, where energy companies would say, well, I think I could do a profitable one here... not, here's where it's going to make the least impact on conflicting uses and on the environment."

When projects are proposed in the absence of credible, legitimate, scale-appropriate, contextual rules and guidelines, salient issues reflect policy gaps and some resort to what one participant called all-or-nothing positions. In environmental assessment, this manifests as development versus protection, or economy versus environment. With the science of overarching policies uncertain and contested, the scientific evidence considered within individual projects appears abstract, arbitrary, incomplete, or irrelevant.

Table 5. Reports Referenced by TMPE Participants in Interviews and Environmental Assessment (EA) documents, n=191

Source	Spills	Biodiversity	Climate	Economy	Other Tags
Academic peer review	16	18	6	1	9
Academic not peer review	10	8	1	1	4
For or by nonprofit	10	3	4	6	10
EA Documents	9	4	1	6	25
For or by other governments	12	37*	2	6	7
Corporate	1	1		1	3
Books	2	2	3		3
Other	2	2		2	4

*32 of 37 government biodiversity reports were submitted by a single participant. Other additional references = partnerships, individual's websites, international conventions, Wikipedia. Other tags = democracy, health, safety, toxicity/contamination/pollution, geology, renewable energy, regulatory, "Green History of the World," Indigenous.

Table 6. News Articles and Blogs Referenced by TMPE Participants in Interviews and Environmental Assessment Documents, n=126

Most Prominent Tag	Neutral* (re 1 TMPE) References for Anti-TMPE	Anti-TMPE References	Pro-oil and Gas References Used in Anti-TMPE Argument	References for Pro-TMPE Argument	Total
Spills	26	14	5		**45**
Biodiversity	4	4			**8**
Climate	17	2	1		**20**
Economy	6	6	2	1	**15**
Health and Safety	10		1		**11**
National Energy Board Process		3	1		**4**
Corporate Integrity	1	7	2	1	**11**
Government Integrity	1	1			**2**
Activist Integrity			1		**1**
Indigenous	1	1			**2**
Renewable Energy	2				**2**
Jurisdiction			1		**1**
Place Attachment		1			**1**
Security		1			**1**
Social License				1	**1**
Spirituality	1				**1**
Total	**69**	**40**	**14**	**3**	**126**

*Note: Articles were considered neutral if they did not mention the TMPE, however they may have been biased in another context (e.g., articles about the Exxon Valdez spill in Alaska).

Legitimacy

Trust in the Regulator

Project supporters respected the history and structure of environment authorities, and the professionalism and integrity of panel members and staff, often citing personal experiences with them. Attempts to denigrate the NEB and its panel members were seen by some as scurrilous. Before any appointment, panel members were interviewed to determine whether they had the required skill set and any conflict of interest. Prior to hearings, they met to discuss issues and logistics, visit project areas, consult with government experts, and interact with support staff. Expert staff were described as highly qualified engineers, economists, biologists, and other professionals with a solid understanding of the issues and extensive experience from many different projects.

Like other organizations, environmental assessment authorities had a distinctive culture; in the case of the NEB, it was to support free enterprise without harming the environment. "The mantra at the NEB during my time there was "protect and enable," one participant said. Another described it as "approve with conditions." They trusted panel members to learn the evidence well enough to weigh it. Notably, two of three panel participants surveyed claimed they would be neutral when energy projects conflicted with environmental protection. The third reported he would probably lean toward energy projects but was equally suspicious of companies and environmentalists.

If information is embedded in a process believed to be unfair, then it will not be regarded as legitimate (Cash et al., 2002). Whereas Bute Inlet opponents were comfortable with the pending federal process, Trans Mountain opponents saw panel members as the political appointees of a pro-pipeline government working behind closed doors with the proponent and others towards a predetermined outcome. As a result, many Trans Mountain opponents felt *they* held the burden of salvaging the legitimacy of the process.

Weighing Conflicting Science

Consistent among participants was a belief that all environmental assessment science should be scrutinized, by validating assumptions, methods, and interpretations. Oral cross-examination was seen as an important way of scrutinizing evidence within the assessment process. Although there were more than 90 days of cross-examination in the Northern Gateway environmental assessment, the Trans Mountain review favored written questions to the proponent over oral questioning of live witnesses defending their own evidence. In lieu of oral cross-examination, there were two rounds of written information requests, a single opportunity to file written evidence, and another to orally present a final argument devoid of new evidence.

Whereas project supporters saw ample opportunity for rebuttal in the written process, opponents felt it impeded opportunities for clarification and in-depth analysis. The NEB was viewed as complicit in errors of omission by neglecting their duty to compel better responses and by ruling in favor of the proponent in most cases. The company had opposed the motion to allow oral cross-examination because, "the Board is the master of its own procedure" (NEB, 2014, p. 2). In ruling 14, the NEB justified its decision to forego cross-examination by stating that, "the legislation [i.e., the revised NEB Act and Canadian Environmental Assessment Agency (2012)] makes it clear that the Board is master of its own procedure" (p. 5). The Expert Panel (2017) recommended a transparent and collaborative expert review exhibiting how decisions reflect the evidence and criteria for decision-making to demonstrate how trade-offs are made.

Participants from both projects raised the idea of a fact base. This was both an ongoing repository for evidence collected over time (e.g., a clearinghouse with both project-based and longitudinal studies), and an approach to address conflicting evidence (e.g., a tie-breaking science officer who had the ability to commission and aggregate studies). Bute Inlet participants, given the luxury of time and space with the project in abeyance, began to cultivate a fact base outside of the assessment process, through a collaborative Energy Forum and in developing a decision support tool.

Weighing Indigenous Knowledge

Similar to the Expert Panel (2017), participants recognized the challenges of weighing Indigenous knowledge with western science in environmental assessment. For two Indigenous participants, the disregard for their oral histories left them feeling misunderstood, and the prospect of large profits exiting their territories without due process continued the injustices wrought by colonization (cf., Kojola, 2019). One non-Indigenous participant felt the legitimacy of

Indigenous knowledge was frequently undermined by the politics of treaty processes. Three others, all non-Indigenous, believed Indigenous knowledge should be given as much or greater weight in decision-making than other forms of evidence, but also felt it should be subject to similar scrutiny (i.e., recognizing its limits, encouraging it to be challenged). Since Indigenous knowledge is typically entwined with deep senses of place and infused with moral principles and spirituality (Clermont, 2018; Clermont, Dale, Reed, & King, 2019), the act of weighing it with other knowledges is best accomplished alongside Indigenous people who understand its value and significance.

Weighing Public Opinion

Although the Conservative Government had narrowed the definition of standing in environmental assessment, thousands of people registered to participate in the Trans Mountain and Bute Inlet assessments. That so many people might seek standing in a review process was troublesome to panel members in particular. Aside from the costs and logistics of managing large numbers of people and effectively weighing the resulting volumes of data, such inclusiveness had the potential to turn an evidence-based process into an endless process of engagement decided on a show of hands. While panel members fondly recalled highly structured assessments, with fewer than 20 skilled intervenors and experts identifying technical issues that could be addressed through project modifications, opponents felt arbitrarily and unduly silenced by the new restrictions.

Despite their low ranking of public opinion, opponents typically demanded projects be approved only if they have broad public support or social license. This reflected how their agency lay in numbers, rather than tangible power (Clermont, 2018). The Expert Panel (2017) believed the process could only contribute positively to a project's social license if it embraced the concerns of affected parties through meaningful public engagement. It recommended early and ongoing legislated participation opportunities open to all, with results having the potential to impact decisions. However, we suggest securing social license is more appropriate to higher-level planning processes that address policy gaps at appropriate scales and within useful timelines. Whether energy projects are needed, and their numbers and locations, should be determined prior to more technical, project-specific environmental assessments.

Conclusion

Perceptions of science, taken collectively, were rife with seeming contradictions. Participants viewed science as biased (e.g., by financial interests) but more generally as objective fact. The public was seen as engaged with the project, but uninformed on its aspects. With environmental assessment projects beset with complexity, ambiguity, and uncertainty, participants took cognitive shortcuts, deferring to interpretations by others, for example.

Deferring to others was subject to the mechanisms of cultural cognition, all of which can filter and amplify certain information over others. For example, the cultural availability effect was invoked when people chose information from partisan media or turned to sector and advocacy groups to access project information. In turning to news media and search engines, people were vulnerable to filter bubbles and echo chambers. Some shortcuts were enshrined in the culture of organizations, such as the "protect and enable" mores of the NEB. The perceived level of integrity of the assessment authority influenced whether the process it led was viewed as legitimate. The relative salience and credibility of scientific information, and indeed all assessment information, was seen through the various lenses of cultural cognition (Figure 1).

In a post-truth era, science and science-based decision-making are fundamentally important to systematic knowledge-building and to democratic processes sustained by a knowledgeable public. Yet, best available science, and evidence- or science-based decision-making must be more critically assessed, given the breadth of biases in environmental assessment. Throughout history, philosophers and others have deliberated the role of values and the truth of facts in science. Currently, objectivity in science is best understood as unattainable, and an ideal to which scientists and others might aspire to reduce epistemological, personal, institutional, and other forms of bias (Reiss & Sprenger, 2017). Similarly, facts are not unarguable truth (cf., David, 2016), but must be examined in context, since people prioritize certain verifiable facts over others.

The values woven through scientific research, dissemination, and use must be made explicit, to the greatest possible extent. To manage the effects of values-based bias and cultural cognition is to make environmental assessment science more widely salient and credible, and the process more just. Our participants suggested developing a salient

and credible fact base, and the Expert Panel (2017) recommended that weighting be removed from environmental assessment processes altogether, by weaving together scientific, Indigenous, and local knowledge throughout. This would entail, for example, Indigenous and community knowledge-holders collecting standardized, publicly available baseline data alongside scientists (Kojola, 2019).

There are a number of challenges here, the most significant of which is a fundamental lack of understanding as to precisely how different knowledges can be judiciously and fairly integrated. While Indigenous knowledge shares certain characteristics with western science—being constructed by many individuals observing patterns over time—it is embedded with spirituality, entwined with connections to all aspects of place, and managed with great responsibility by knowledge keepers, language speakers, and traditional users (Snively & Williams, 2016). It may also be fragmented by the consequences of colonialism (Whyte, 2017). Local knowledge lacks structure, since it is rarely compiled in a standardized way. Accounting for public opinion in assessment and striving for social license is another challenge, since inclusiveness must be weighed against the sheer volume of input, with legitimacy suffering if there is too much of one or the other. Raymond, Fazey, Reed, Stringer, Robinson, and Evely (2010) warned that integrating different forms of knowledge must include new processes to examine the validity and reliability of knowledge claims, and to make explicit the epistemological beliefs of those involved. The innovative integration of knowledge from diverse sources, including public opinion, would assist in expanding the opportunities for direct community engagement in environmental assessment and is an important area for future research and practice.

Yet, if environmental decision-making was truly science-based, grounded in the latest peer-reviewed science with local expertise and longitudinal Indigenous knowledge, would there have been the same level of conflict? Likely yes. Science-based conflicts are often values-based conflicts, therefore more data is largely ineffectual (Floor, van Koppen, & van Tatenhove, 2019; Miscolta-Cameron, 2016). Arguments over the science of bitumen behavior in marine waters were less about cleanup techniques than whether treasured places and species such as the iconic Killer Whale should be protected from potential harms (Clermont et al., 2018). The inclusion of the science of upstream and downstream greenhouse gas effects in assessment was really about the felt urgency of transitioning to renewable energy (Clermont et al., 2018).

Since science in environmental assessment is commissioned, selected, and analyzed through the lenses of cultural cognition, there is little opportunity for science-based decision-making devoid of values. Making values explicit in evidence may do little to change this, as any evidence intertwined with values lacks salience and credibility for people who do not share those values. Decision-makers faced with complexity and uncertainty are even more likely to make values-based rather than evidence-based decisions (Kahan, et al., 2011; Miscolta-Cameron, 2016). In essence, the environmental assessment process produces a predominantly value-based and political decision masked as a science- or evidence-based one.

Due to the influence of culturally biased assimilation and other mechanisms of cultural cognition, unbiased environmental assessment decisions cannot be made by politically appointed panel members and those who appointed them. Nor can they be made by a vociferous public in pursuit of social license. The Expert Panel (2017) recommended the creation of an Impact Assessment Commission with the capacity for planning and assessment, western science, Indigenous knowledge and relations, community knowledge, public participation, proponent liaison, information management, and monitoring and enforcement. In the absence of a diversity of values among decision-makers, the process is susceptible to deteriorating legitimacy.

However, when groups in conflict are evenly empowered to meaningfully participate in decision-making, the roles of science may shift. In their study of a mussel fishery controversy in The Netherlands, Floor, van Koppen, and van Tatenhove (2019) found that opposing groups, bound by a legal agreement to develop solutions together, no longer used scientific arguments to support their positions. Rather, they used the processes and findings from research projects to build cooperation, increase the complexity of their arguments, engage in shared fact-finding, and develop mutually beneficial monitoring and adaptive management programs. With participation and agency, science played more of a procedural and instrumental role. This suggests that participatory knowledge to action

research partnerships may be pivotal to enhanced environmental assessment science and its equitable use.

A recommendation of the Expert Panel (2017) was that new knowledge be pursued when it is perceived to be lacking. If it is important to know whether bitumen will sink, or to come to some consensus regarding the time it could take to transition from fossil fuels to renewable energy, teams of scientists and others could then be dispatched to learn more. This is science as learning, to inform and engage participants in critical deliberation, rather than to prove or falsify hypotheses.

We believe that the foundations for future work in this area are already established, with many scholars now engaging with community practitioners and members of the public in transdisciplinary and transformational learning research partnerships. Continuously reflecting and adapting, group members work to co-design and co-produce targeted research and research products while integrating knowledge systems, exploring worldviews and values, and addressing issues of equity, diversity and inclusion (Diduck, Sinclair, Hostetler, & Fitzpatrick, 2012; Lang, Wiek, Bergmann, Stauffacher, Martens, Moll, Swilling, & Thomas, 2012). If planning and review processes were to embrace participatory forms of research, and emphasize research that is driven by curiosity rather than support for a position, we might expect the findings of such research to be more salient, credible, and legitimate among diverse audiences. We may also see a more prominent role for scientific evidence in decision-making, and perhaps fewer or less intense environmental conflicts.

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